Memo

From: Erin Foresman

To: Karen Schwinn

Re: Notes from March 27, 2012 Estuarine Habitat Workshop, Plenary Session. The notes below describe what I heard and understood participants to be saying to the best of my ability.

Date: March 29, 2012

Individual speakers are identified by their names.

Recorders provide summaries of what they heard from each workgroup. Recorders identified with full name.

Ted Sommer – Question 3: What are the drivers in the quantity of estuarine habitat during each season of the year? What are the drivers in the quality of estuarine habitat, including the location of the LSZ, during each season of the year. What biological indicators respond to changing locations of the LSZ between the Carquinez Strait and the western Delta? At the workshop, you'll be asked to fill-in the attached chart of Biological Indicators and Metrics. A sample is attached to stimulate your thinking, and you're encouraged to come to the workshop with ideas for completing this chart.

Initial assumptions:

- Estuarine habitat = low salinity zone
- Quantity = area/areal extent

1st part: Drivers/Factors affecting habitat quality

- Flow (inflow, outflow, exports as a function on water demand, floods)
- Bathymetry landscape geometry
- Tides
- Wind/barometric pressure
- Water control structures – Suisun marsh
- Antecedent conditions – what happened the previous month and season

We know a good amount about the drivers and know less about the processes. Processes and spatial gradients are the more important factors.

Spatial gradients will vary depending on location of lsz.

Different groups rely on different processes, therefore responses of different groups will vary – benthic groups v. pelagic groups

Finally, struggled with separation of quantity and quality. Habitat quality and quantity are interrelated.

2nd part focused on LSZ, water quality for biota not other things like navigation, recreation etc.

Physical, biological, chemical factors – the highlights

- Depth
- Turbidity
- Temperature
- Light availability
- Hydrodynamics:
    - Vertical stratification
    - Vertical shear
    - Lateral shear
    - Residence time
    - Water control structures
    - Rip rap
- Month ball fleet

Biological Factors

- Food availability – phyto & zoo plankton, phyto quantity and quality, available carbon, macro-invertebrates.
- Predation & competition
- Metrics that can estimate the effect of predators
- Jellies
- Filtering rates
- SAV & floating aquatic vegetation
- Recreational harvest'
- Wetland plants

Chemical Factors

- Nutrients concentrations and ratios
- Contaminants concentrations
- DO and pH

Biological Indicators that changed east of Carquinez Straight

- Did not identify a detailed metric that was the ultimate goal of the discussion
- Outline
    - Most discussion about how various indicators responded to changes in LSZ.
    - Focused on important things to biota, not everything there's to measure. Not all things are going to be worth measuring out of the long and endless list that you could measure.
    - Focus on biota, minority opinion to broaden to factors that are important to biota like turbidity.

- Delta Smelt, long fin, American shad, distribution and abundance variable for different species that there is more or less certainty about whether we have evidence to support this.
- More detailed metrics – interest in health condition, growth rates (chronic toxicity stuff?), especially for the 4 POD species.
- Biomass
- Food availability, distribution, quality of different groups (phyto- and zooplankton etc…)
- HABs
- Wetland plant diversity
- Scoter and scaup distribution
- Predation rates
- Patchinessd

Questions: none.

Steven Culberson – Question Four: Given the historical and present-day relationships between the LSZ and the landscape of the Bay Delta, how can models be used to forecast the response of biological indicators to changing precipitation patterns, rising sea levels, and restoration scenarios?

Take-homes:

- Use 3D models for scenarios
- All 3 groups held v. strong opinions about how this is a sociological enterprise. We appreciate the importance of having these discussions. In the discussions, the socio-dynamic component was as or more important than the models.
    - Profound level of exasperation of how we approach science as a community of technical experts. Hope these discussions will be different.
    - We were undaunted by technical requirements of models – how difficult it is to get the right people in the right room to discuss the right things at the right time. Need an ongoing process on which to base a rich scientific view point.
- Conservation approach would benefit from an imposed constraint.
    - Discussion in abstract
    - Please put something down on a map and ask us what we think about restoration of a potential actual area. Please tell us what landscape you are talking about, then we can tell you something about it.
    - A vague idea of 80K acres of some kind of habitat is not something we can provide feedback about.
- Expectations from modeling
    - A range of responses is available. Please expect a range of possibilities or options: good - bad – ugly. Exact predictions are highly unlikely, exact predictions are highly uncertain.
    - As good as the 3-D hydrodynamic modeling is, the biological models will not be there any time soon. Don't expect biological models to be that good.

- A reasonable way forward
    - Predict Experiment Evaluate
        - 1. Ammonium experiment: figure out if ammonium inhibition is happening in the estuary
        - 2. Foodchain augmentation experiment: food chain conditions based on residence time – sample organisms (i.e. delta smelt) to see how they responded to additional food response.
    - What could help models are field results.
- A common tension in the groups is the idea that there are different modeling approaches – could be good thing though
    - Disagreements: physical vs. biological perspectives.
    - Plea from physical modelers to biological community : the physical community needs specific recommendations for biological model outputs (6 or 7)

Les Grober – Question 1: What are the key points of scientific agreement, disagreement, and uncertainty surrounding estuarine habitat and aquatic life in the Bay Delta Estuary? How could scientists and agencies "manage the uncertainty" while advancing the protection of water quality and estuarine habitat?

- LSZ is an important measure of estuarine habitat for certain species. LSZ not necessarily equal estuarine habitat
- Habitat = salinity, temperature, turbidity, physical properties, gradients, volume, depth, variability at all scales, connectivity
- LSZ is v. productive area in an estuary relative to other parts of the system.
- What is a master variable – flow v. changes in nutrients, whole concept of a master variable is flawed because all measures of habitat are important and can be used t understand responses of species.
- LSZ is more important to pelagic species, less for salmon and steelhead.
- More certainty re pelagic aquatic life, less wrt salmon and sturgeon
- Less connectivity when X2 is upstream, connectivity increased with X2 more seaward
- LSZ is the middle of a range of habitats
- Lots of agreement on aquatic life trends, less agreement on mechanisms; need more agreement on biological and ecological effects or causes of those trends.
- LSZ upstream increases entrainment, disagreement about LSZ and populations
- Struggled with concept of uncertainty. Nature of struggle is the fundamental disagreement about the roles of flow vs. nutrients.
- Agreements vs. disagreements vs. uncertainty
    - Disagree: quality of habitat
    - Agree:
        - Quantity of habitat
        - Diversity creates resilience

            - Measurement can address uncertainties in details
    - Disagree: quality of habitat
    - Uncertain:
        - Quality of habitat
        - Edges: measurement
        - Where is LSZ: measurement

John Rosenfield. Question 2: What is needed to update and improve the State's current approach of managing estuarine habitat with a springtime salinity standard (FEB-JUN)? What key scientific findings and emerging modeling techniques should be applied?

- Needs:
    - Need to capture variability in flows
    - Cost-benefit analysis of incremental increases in outflow
        - Multi-day intensive workshop on this question
            - Capture multi-species variability in responses to these flow changes
            - Research since 1995 should be applied
- X2 provides an index of multiple functions for fishes.
- Standard that operates one way for many fishes though it may affect them individually in different ways.
- Make the X2 requirement responsive to the flow-response relationships of abundance. Link it closer to responses. Temporal scale closer than one month compliance.
- Pulse flows might be more important than monthly averages of X2.
- Improve relationship between X2 management and linking those specifically to species biology.
- X2 recommendations identify uncertainty for each fish.
- Craft more than one set of standards and manage adaptively to determine what set of standards works best.
- Year round standard of X2 where we prevent the zero-sum game of benefits felt in one season are replaced by equal or greater negative impacts in another season.
- Suggestion to have an extensive multi-day workshop on this question.
- Tie species to variables driven by X2 or flow.
- If you have X amount of water, how would you allocate that water throughout the year. Gets down to the hard question of limited water in the system.
- Integrate biological research and biological modeling so that it is very hypothesis testing driven.
- Use improvement in otolith techniques to improve life history analyses.
- Develop budgets for food and turbidity to describe fish habitat as a function of LSZ locations temporally and spatially to show how you can optimize flow for habitat characteristics that support fish pops.
- Since X2 has been passed, pops declined so it is not a good regulation.
- Improved storage provides more flexibility for adaptive management
- Acknowledgement that adaptive management is hard when supply is constrained.
- Better at developing conceptual models that inform research programs.

- Understand foodweb dynamics better but not completely

Brock Bernstein – additional comments

Q. how did historical presentation affect your views or discussions?

Steve Culberson – Robin's work isn't new information but a fundamental working hypothesis

Robin Grossinger – hopes that this group can interpret the implications of the historical ecology (HE) study

Bruce Herbold – Robin didn't stress the incursion of salinity had been a lot less than I had previously. The restriction point pretty strong resistance to tidal incursion.

Randy Baxter – interesting about the freshwater reservoirs and how they affected low salinity water.

Robin Grossinger. – many factors that we can hypothesize resisted the tidal incursion (diversity of channels, discontinuity of channels, natural reservoir storage). Interesting to see older historical processes modeled.

Brock Bernstein – How do you take HE and stick it into models like UnTRIM? How do you model historical processes with 3-D models that require so much data required?

Michael MacWilliams – No problem w/bathymetry. Flows are difficult, but bathymetry is relatively simple. Hard part is the hydrology. Base flows would be difficult to get a range that is supported. Could be working if anybody has info on baseflows.

Stephen Monismith – I would suggest starting w/ simple calculations and explore smaller elements, how would the pieces work. How big were the flood basins, how much water could they hold. How might tide propagation in a restricted network of small channels work?

Chris Enright – 1847 showing 2-feet of tide in Sacramento in 1850-something. Historical perspective is not part of the discourse right now, not part of the narrative. Don't see perspective is in everybody's head. Historical perspective is revolutionary, makes discussion rich over time. Look forward to it.

Robin G. – water and the landscape are important driving factors that determine habitat and quality.

Chris Enright – that connects to concept of unimpaired flow, we know it is not natural but folks think it is close enough. Robin G.'s presentation shows the natural hydrograph is probably enourmously different and where it is going is v. different. The natural hydrograph is possibly enormously important.

Brock Bernstein – …to inform restoration planning.

Randy Baxter – yes, and where the water is going is very different in historical condition.

Bruce Herbold – we've moved from how loss of islands will flood and pollute delta with salt water to how restoration of wetlands will keep salinity intrusion at bay, where restoration of islands will possibly

leave salinity? Salinity intrusion question is not settled.

Brock Bernstein – My impression is that the hydrological models are pretty good. That's not so much true for biological models. How much more can we predict?

Randy Baxter – the hydro models seem to be pretty robust and yet the models of how the biology would respond are less good. How can we improve the biological models. What are the opportunities and constraints to improving the bio models to inform how LSZ impacts biological indicators?

Stephen Monismith – starting point of the first x2 workshop. Improving existing biological models for predictions is fairly doable, if you don't expect that things will work like that. They are not applicable for forecasting. Improving bio models are achievable but not in the predictive functioning like engineering forecast models. You would learn a lot. Why is there not a 3-D phytoplankton model? Good Q. We should just do it and start playing it. It would allow us to better inform debates/discussions about ammonium, benthic grazing, etc…Why not developing a 3D phytoplankton model? Why not for fish?

Anke Mueller-Solger – IEP did a review of modeling and fish management – one comment 'why is it that most sophisticated fish models use the least sophisticated physical models? Now is the time to do it. Hydro and fish models need to go together.

Stephen Monismith – match levels of sophistication between models. Humbling modeling exercise for copper based on residence time which turned out to be the least important variable in the copper model.

Stephen Monismith – let's do an exercise with Jim Cloern and Dick Dugdale doing phytoplankton modeling for S and N Bay respectively and have them talk.

Mark Stacey – caution about pushing 3-d models directly to fish. Inform thinking about the higher levels even though you are not explicitly linking them. Perhaps start with phytoplankton, not fish.

Stephen Monismith – an open question if you start modeling phytoplankton could do pretty well on biomass but get fluxes v. wrong and where they are in the water column.

Michael MacWilliams – link mechanisms/Stephen Monismith's model to X2 conditions. Also look at incremental cost benefit of distributing water through out the year. See that some regs have unintended consequences. Manage X2 in the spring w/ unintended consequences in the fall. A 3D model would be valuable for evaluating cost-benefit of incremental increases of X2.

Stephen Monismith – Most important thing: intelligent use of the models. Something as simple as it can be; only as complex as it has to be.

BJ Miller – We went through a sequence of failures that might be useful for others. We started years ago with single variable analyses and we realized that if multiple variables are the cause then we are not getting good info from our single variable analyses. Then with multiple variables we received results that were difficult to interpret. We selected based on perception of importance, we should select

variables on their mechanism of effect. Whether they directly affect fish species. If it is flow – what aspect of flow because it brings in turbidity or nutrients. Is it flow and it is drawn toward the pumps? We switched to analyzing variables in terms of their mechanisms of affect and that has given us more useful results. If you keep doing that you can determine a hierarchy of effects. We need to go down the hierarchy of effects, and then we can establish linkages that can be used.

Bruce Herbold – MM mentioned using models in a circular process to hind-sight and forecast data. Hind-sight can be used for correction and used for informing monitoring programs and designs. This something that we can now get mechanisms for biology and 3-D models that look something like the real world. Rethink monitoring to provide data that can be used w/ our new tools. We can use models to hindcast data. We can use the hindcast to identify physical data needed to understand biological data; this informs the collection of monitoring data. It would be useful if we look at old data through that lens.

Randy Baxter – LSZ = Estuarine habitat for key species ???

Jon Rosenfield – strongly suggest to remove [sic] habitat from our vocabulary b/c of all the things habitat can mean. It is not useful for all the things and variables it can mean. Habitat value of flowing water is very different than it is for a resident species. It becomes "n-dimensional hyperspace" it becomes either way too broad to be useful or too narrow and down to species to be helpful in a broad sense.

There is one broad agreement: the better we understand mechanisms, the better we are able to understand and manage species.

We have v. strong relationships our continued study is to fine tune that management. Their habitat is water; they don't know about the water-ground boundary.

Brock Bernstein – Re: habitat: it's not meaningful in ways we need it to be.

Jon Rosenfield – Yes, especially...

BJ Miller –absolutely agreed, on behalf of 40+ water agency scientists.

Matt Nobriga – I agree w/Jon that we can define habitat as outflow-based etc. but this is too broad to be useful but I want to draw a distinction – you can broadly define habitat like things about the estuary that are extremely general. Habitat can only be defined by species. For any specific species; it is n-dimensional but after a few dimensions it isn't that relevant. The way forward is that we do know 20-more years of technical data for all species that EPA could hope to protect with a low salinity zone area and see how well you do, and deal w/responses and mechanisms species by species. This is a way to a multi-species answer. Questions, MN thinks are mostly relevant to delta smelt.

Jon Rosenfield – Beauty of X2: we don't know mechanisms behind it but it works.

BJ Miller – broader issue that troubles BJ. Not useful to say "we don't have enough habitat" if there is a

contaminant that's causing the problem. Suppose in this estuary there is a contaminant that directly kills fish. Concentration in much of the estuary is at levels that kill fish. Someone asks what is the problem, it doesn't seem to me that it would be a contaminant problem, not enough habitat. Then it is not useful to define the problem in terms of habitat.

Randy Baxter – aren't there all sorts of regulations that deal with those contaminants.

BJ Miller – why should we feel compelled to define the causes of these problems in terms of the extent of habitat.

Bruce Herbold – likes to think about: what are the positive features that the species of interest need? Each species has positive needs, habitat requirements etc. We issued an ANPR last year, a number of the issues are clearly bad things for fish habitat. Three things are positive features, habitat that species require. It has been over a year since we issued it and BH still trying to get at how you protect the positive features or identify the role of those positive features because you need enough habitat but you can ruin that habitat by poisoning it with contaminants. What are the positive; things the species require? What are the things that kill off the species. All these things are the problem. EH habitat in a variety of seasons has shrunk a lot. It won't do fish any good if contaminants are dealt with but they don't have a place to live. Not not dealing with the negs, but addressing them by ruling out.

Randy Baxter – I don't hear you completely ignoring contaminants.

Bruce Herbold – you can't restore a fish population if they fish don't have a place to live or if that place is jammed with microsystis.

Les Grober – I don't think anyone is advocating that we not look at or address contaminant issues. Water Boards are addressing those issues. We are not suggesting it is either or; we are addressing both.

Anke Mueller-Solger – we are talking about an estuarine salinity gradient. Can we talk about all the other things in the future? Agrees with Jon. Do we have to call it habitat? Can't we just agree on low salinity gradient?

Josh Israel – That's not what the groups decided, there's more to it. The LSZ is very important for resident species and has some importance to migratory species.

Brock Bernstein – Matt Nobriga suggested a way out: define species of concern and their requirements.

Stephen Monismith – all of the stuff that is downstream of the Delta, low salinity gradient/X2 has other implications for other components, i.e. downstream ecosystems and species downstream of the system. e.g. *Crangon franciscorum* recruitment etc. Exchange out through the golden gate is exchanged. The whole downstream ecosystem is altered by where X2 is sitting.

Erwin Van Nieuwenhuyse – the low salinity gradient is also important for phytoplankton abundance. In addition to managing LSZ we could manage phytoplankton composition. We can't control T and turbidity is a long shot but we could do experiments about how to get more phytoplankton in the

system. We could make recommendations for bringing more phytoplankton into the Bay. We would use water to get it there.